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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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EXAMINER

KUMAR, PANKAJ

ART UNIT	PAPER NUMBER
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2631

23

DATE MAILED: 01/09/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

09/237,356

Applicant(s)

CHENNAKESHU ET AL.

Examiner

Pankaj Kumar

Art Unit

2631

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 29 July 2003.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-13 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-13 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on _____ is: a) ☐ approved b) ☐ disapproved by the Examiner.
- If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

- 13) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
- a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____.
- 4) ☐ Interview Summary (PTO-413) Paper No(s). _____.
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: _____.

DETAILED ACTION

Response to Arguments

1. Applicant's arguments filed have been fully considered but they are not persuasive.

2. Applicant argues on page 4 that "... the sequence that Kumar is estimating is the information bit sequence, using the equalized received symbols. By contrast, the present invention estimates the sequence of transmitted symbols performing the equalization process"

This is not persuasive for a number of reasons. First, applicants have claimed a receiver and the Kumar reference is a receiver (i.e. fig. 9 in Kumar is a receiver). Second, applicants have mischaracterized Kumar by implying that the equalized received symbols are not an estimate of the transmitted symbols since they estimate an information bit sequence. It is inherent in Kumar, as it is in a general receiver, for the receiver to estimate what the transmitter transmitted, such as the information bit sequence; otherwise the transmitter/receiver system will not be functional.

3. In response to applicant's arguments, the recitation 'non-linear MLSE equalizer' has not been given patentable weight because the recitation occurs in the preamble. A preamble is generally not accorded any patentable weight where it merely recites the purpose of a process or the intended use of a structure, and where the body of the claim does not depend on the preamble for completeness but, instead, the process steps or structural limitations are able to stand alone. See *In re Hirao*, 535 F.2d 67, 190 USPQ 15 (CCPA 1976) and *Kropa v. Robie*, 187 F.2d 150, 152, 88 USPQ 478, 481 (CCPA 1951).

4. Applicant argues that MLSE is part of decoding and not equalization in Kumar. This is not persuasive since decoding is connected to equalization in Kumar.

Art Unit: 2631

5. Applicant argues that filter weights are hypothesized and not the symbols in Kumar. This is not persuasive since in Kumar's adaptive filter, filter weights are determined based on a hypothesis of what the symbol is.

6. Even though col. 43 lines 43-45 refer to a transmitter in Kumar, what is transmitted is also what is attempted to be received. Accordingly, if the transmitter were performing one operation, the receiver would perform a complimentary operation in order to attempt to recover what is transmitted.

7. Applicant argues that convolving does not imply lookup. This is not persuasive since during the operation of convolving, multiple pieces of information need to be looked up such as the filter coefficients – even if such data is changing.

Claim Rejections - 35 USC § 112

8. The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

9. Claim 13 is rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

10. Claim 13 recites the limitation "multi-channel non-linear ... MLSE" in the preamble but then in the body of the claim recites, "said multi-channel MLSE". Accordingly, there is insufficient antecedent basis for "said multi-channel MLSE" in the claim.

Claim Rejections - 35 USC § 102

11. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

12. Claims 1, 2, 3, 4, 5, 9, 13 are rejected under 35 U.S.C. 102(b) as being anticipated by Namekata USPN 5673294.

13. As per claim 1, Namekata teaches in a receiver a method for determining a branch metric in a non-linear maximum-likelihood sequence-estimation equalizer which receives at least one antenna signal modulated with M-ary modulation, said method comprising the steps of: pre-computing values (Namekata cols. 9-10; col. 10 lines 10 to 11: “ ... equation (7) ... can be calculated in advance ... ”) equal to a product of a complex number (Namekata cols. 9-10; col. 10 equation 7: $X^*(k)$) and a ~~hypothetical~~ hypothesized symbol value (Namekata cols. 9-10; col. 10 equation 7: $X(k)$ is hypothesized since col. 10 lines 5 to 7 say: “... $X(k)$ is determined only by a known signal source of a finite length ... up to time k or a survivor path of a given state at time $k-1$, and a path from the given state to an arbitrary state at time k ”; also col. 9 lines 48-51: “Converging $X(k)h(k)$ to $r(k)$... $r(k)$ is the estimated received signal vector at time k .”; also col. 9 lines 33-35: “... mapping $s(k)$ according to a predetermined modulation method is represented by $x(k)$... ”); storing said pre-computed values in a product table (Namekata cols. 9-10; col. 10: matrix); adding select pre-computed values from said product table to produce a result (Namekata col. 10: $X^*(k)X(k)$ added to the unit matrix); and determining said branch metric

Art Unit: 2631

using said result (Namekata col. 3 line 14: "The branch metric is calculated ... "). (Namekata also see cols. 1-2)

14. As per claim 2, Namekata teaches the method of claim 1 wherein said complex number corresponds to a channel coefficient (Namekata col. 10 equation 7: channel coefficient h is equal to some function of a complex number within X^* ; col. 9: h^*).

15. As per claim 3, Namekata teaches the method of claim 1 wherein said complex number corresponds to a s-parameter (Namekata col. 9 lines 33-35: "... mapping $s(k)$ according to a predetermined modulation method is represented by $x(k)$..."; col. 10: X^*)

16. As per claims 4, 5, 9, and 13, the discussion for claims 1 and 2 above apply.

Claim Rejections - 35 USC § 103

17. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

18. Claims 1,2,4,5,6,7,9,10,12,13 are rejected under 35 U.S.C. 103(a) as being unpatentable over Kumar US patent no. 5,949,796.

19. As per claim 1, Kumar teaches in a receiver a method for determining a branch metric (col. 31) in a non-linear maximum-likelihood sequence-estimation (not in Kumar but would be obvious as explained below) equalizer (fig. 9) which receives at least one antenna signal (fig. 9: input to 201) modulated with M-ary modulation (col. 65: line 67; col. 33: paragraph 8), said

Art Unit: 2631

method comprising the steps of: pre-computing values equal to a product of a complex number and a ~~hypothetical~~ hypothesized symbol value (Kumar col. 43 lines 43-45: filter coefficients are convolved by input symbols where convolution inherently means multiplying, storing, and adding); storing said pre-computed values in a product table (Kumar col. 43 lines 43-45: part of convolution; col. 31: lines 25-27 “accumulated”); adding select pre-computed values from said product table to produce a result (Kumar col. 43 lines 43-45: part of convolution; col. 31: lines 25-27 “accumulated”); and determining said branch metric using said result (Kumar col. 31: lines 25-27 “accumulated ... branch metrics ... are compared”).

20. Kumar does not teach non-linear maximum-likelihood sequence-estimation. Instead, Kumar has in paragraph 65: “The coefficients of the equalization filter are determined by a tap-weight update algorithm and are updated at a rate sufficient to reasonably track changes in the RF propagation characteristics. Known methods for equalization include, but are not limited to, minimum mean square estimation (MMSE), least mean square (LMS), and recursive least square algorithms (RLS). Decision-feedback equalization, where the tap-weight coefficients are determined using bit estimates determined after demodulation of the received signal, may also be implemented.”

21. It is common knowledge that one algorithm such as MMSE can be replaced by another algorithm non-linear MLSE.

22. It would have been obvious to one skilled in the art at the time of the invention to modify Kumar to teach non-linear MLSE instead of MMSE, LMS, etc.

23. One would be motivated to do so if non-linear MLSE provides better performance.

Art Unit: 2631

24. As per claim 2, Kumar teaches the method of claim 1 wherein said complex number corresponds to a channel coefficient (Kumar col. 43 lines 43-45).
25. As per claims 4, 5, 9, and 13, the discussion for claims 1 and 2 above apply.
26. As per claim 6, Kumar teaches the filter according to claim 5 wherein said branch metric is an Ungerboeck branch metric (Kumar col. 48 lines 31-32).
27. As per claim 7, Kumar teaches the filter according to claim 5 wherein said branch metric is an Euclidean branch metric (Kumar col. 51 line 52).
28. As per claims 10 and 12, the above discussion for claims 6 and 7 apply.
29. Claims 3, 8 and 11 are rejected under 35 U.S.C. 103(a) as being unpatentable over Kumar in view of Arslan et al. US patent no. 6,108,517.
30. As per claim 3, Kumar teaches the method of claim 1. Kumar also teaches complex filter coefficients as discussed in claim 2.
31. What Kumar does not teach is a reference to an s-parameter.
32. What Arslan teaches is a reference to an s-parameter (fig. 9).
33. It would have been obvious to one skilled in the art at the time of the invention to modify Kumar to have the s-parameter reference of Arslan.
34. One would be motivated to do so since Arslan teaches in fig. 9 that the s-parameter is used in conjunction with filter outputs for metric processing.
35. As per claim 8, Kumar teaches the filter according to claim 5.

Art Unit: 2631

36. What Kumar does not teach is that said branch metric is a partial Ungerboeck branch metric.

37. What Arslan teaches is that said branch metric is a partial Ungerboeck branch metric (Arslan et al. col. 11 lines 30-32).

38. It would have been obvious to one skilled in the art at the time of the invention to modify Kumar to have the partial Ungerboeck branch metric.

39. One would be motivated to do so since Arslan states that many other metric variations are possible in lines 30 to 31 of col. 11.

40. As per claim 11, the discussion for claim 8 applies.

41. Claims 6, 7 are rejected under 35 U.S.C. 103(a) as being unpatentable over Namekata in view of Kumar.

42. As per claim 6, Namekata teaches the filter according to claim 5.

43. What Namekata does not teach is wherein said branch metric is an Ungerboeck branch metric.

44. What Kumar teaches is wherein said branch metric is an Ungerboeck branch metric (Kumar col. 48 lines 31-32).

45. It would have been obvious to one skilled in the art at the time of the invention to modify Namekata with Kumar's Ungerboeck.

46. One would be motivated to do so if one is using 2/3 8-ary PSK narrowband modulation and based on the teaching in Kumar, a method of 2/3 8-ary PSK narrowband modulation include Ungerboeck.

Art Unit: 2631

47. As per claim 7, Namekata teaches the filter according to claim 5.

48. What Namekata does not teach is wherein said branch metric is an Euclidean branch metric.

49. What Kumar teaches is wherein said branch metric is an Euclidean branch metric (Kumar col. 51 line 52).

50. It would have been obvious to one skilled in the art at the time of the invention to modify Namekata with the teaching from Kumar.

51. One would be motivated to do so since based on Kumar, "Preferably, phases are gray coded within constellations ... so that adjacent (determined by Euclidean distance) bits within the same constellation differ in at most one phase bit."

52. Claims 8 and 11 are rejected under 35 U.S.C. 103(a) as being unpatentable over Namekata in view of Arslan.

53. As per claim 8, Namekata teaches the filter according to claim 5.

54. What Namekata does not teach is that said branch metric is a partial Ungerboeck branch metric.

55. What Arslan teaches is that said branch metric is a partial Ungerboeck branch metric (Arslan et al. col. 11 lines 30-32).

56. It would have been obvious to one skilled in the art at the time of the invention to modify Namekata to have the partial Ungerboeck branch metric.

* Art Unit: 2631

57. One would be motivated to do so since Arslan states that many other metric variations are possible in lines 30 to 31 of col. 11.

58. As per claim 11, the discussion for claim 8 applies.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Pankaj Kumar whose telephone number is (703) 305-0194. The examiner can normally be reached on Mon, Tues, Wed and Thurs after 8AM to after 6:30PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Mohammad H. Ghayour can be reached on (703) 306-3034. The fax phone number for the organization where this application or proceeding is assigned is (703) 872-9314.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 305-4700.



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